NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WASTE STORAGE FACILITY

(No.)

CODE 313

DEFINITION

A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure.

PURPOSE

To temporarily store wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system.

CONDITIONS WHERE PRACTICE APPLIES

- Where the storage facility is a component of a planned agricultural waste management system
- Where temporary storage is needed for organic wastes generated by agricultural production or processing
- Where the storage facility can be constructed, operated and maintained without polluting air or water resources
- Where site conditions are suitable for construction of the facility
- To facilities utilizing embankments with an effective height of 20 feet or less where damage resulting from failure would be limited to damage of farm buildings, agricultural land, or township and country roads.
- To fabricated structures including tanks, stacking facilities, and pond appurtenances.

CRITERIA APPLICABLE TO ALL WASTE STORAGE FACILITIES

Laws and Regulations. Waste storage facilities must be planned, designed, and constructed to meet all federal, state, and local laws and regulations.

Of particular concern are the storage period, embankment freeboard, permeability, and compaction requirements of the New Mexico Environmental Department (NMED) and dam safely requirements of the New Mexico Office of the State Engineer (NMOSE).

Storage Period. The storage period is the maximum length of time anticipated between emptying events. The minimum storage period shall be based on the timing required for environmentally safe waste utilization considering the climate, crops, soil, equipment, and local, state, and federal regulations.

Current regulations from the NMED require effluent storage facilities be capable of containing the maximum daily discharge allowed by the discharge permit for a minimum of 60 days. This is to allow for periods when land application is impractical or impossible due to weather conditions, crop transitions, and other factors.

Freeboard. Current NMED regulations require all embankment waste storage facilities to have a minimum 2 feet freeboard above required design volume.

Permeability. Current NMED regulations require the permeability of waste storage ponds installed without a synthetic flexible membrane liner to not exceed 10^{-7} centimeters per second.

Compaction Requirements. Current NMED regulations require soil compaction of no less than 90% Standard Proctor Density. If the facility is classified as a regulatory dam, the compaction requirement for an embankment increases to 95% Standard Proctor Density.

Dam Safety. Section 72-5-32, NMSA 1997, gives the State Engineer jurisdiction of water impoundment structures that are over 10 feet high from the lowest natural ground surface elevation to the crest of the dam **or** embankment that impound more than 10 acre-feet of water.

If it is proposed to construct an embankment higher than 10 feet or an embankment that will impound more than 10 acre-feet above the lowest natural ground surface elevation (working elevation **and** freeboard), the landowner must file an application with

NMOSE, accompanied by drawings and specifications in the format prescribed by NMOSE Regulations. The NMOSE must issue a permit before construction may begin. Further guidance may be obtained from the National Engineering Manual (NEM) Part NM501, Authorizations.

Location. To minimize the potential for contamination of streams, waste storage facilities should be located outside of floodplains. However, if site restrictions require location within a floodplain, they shall be protected from inundation or damage from a 25-year flood event, or larger if required by laws, rules, and regulations.

Waste storage facilities shall be located so the potential impacts from breach of embankment, accidental release, and liner failure are minimized, and separation distances are such that prevailing winds and landscape elements such as building arrangement, landforms, and vegetation minimize odors and protect aesthetic values.

New storage lagoons and expansion of existing storage lagoons, and land application of wastes shall not occur within 100 feet of any watercourse as defined by 20 NMAC 6.2 1101.GGG. A horizontal setback of 100 feet shall be maintained between storage facilities and private drinking water supply wells. Public drinking water supplies will require a setback of 200 feet.

Design Storage Volume. The design storage volume equal to the required storage volume, shall consist of the total of the following as appropriate:

- Manure, wastewater, and other wastes accumulated during the storage period
- Normal precipitation less evaporation on the surface area (at the design storage volume level) of the facility during the storage period
- Normal runoff from the facility's drainage area during the storage period
- 25-year, 24-hour precipitation on the uncovered surface area of the waste storage facility of the facility
- 25-year, 24-hour runoff from the facility's drainage area
- Residual solids after liquids have been removed. A minimum of 6 inches of depth shall be provided
- Additional storage as may be required to meet management goals or regulatory requirements

Inlet. Inlets shall be of any permanent type designed to resist corrosion, plugging, freeze damage and ultraviolet ray deterioration while incorporating erosion protection as necessary.

Emptying. Some type of component shall be provided for emptying storage facilities. It may be a facility such as a gate, pipe, dock, wet well, pumping platform, retaining wall, or ramp. Features to protect against erosion, tampering, and accidental release shall be incorporated as necessary.

Accumulated Solids Removal. Provision shall be made for periodic removal of accumulated solids to preserve storage capacity. The anticipated method for doing this must be considered in planning, particularly in determining the configuration of ponds and type of seal, if any.

Safety. Design shall include appropriate safety features to minimize the hazards of the facility. Ramps used to empty liquids shall have a slope of 4 horizontal to 1 vertical (4H:1V) or flatter. Those used to empty slurry, semi-solid, or solid waste shall have a slope of 10H:1V or flatter unless special traction surfaces are provided.

Warning signs, fences, ladders, ropes, bars, rails, and other devices shall be provided, as appropriate, to ensure the safety of humans and livestock.

Ventilation and warning signs must be provided for covered waste holding structures, as necessary, to prevent explosion, poisoning, or asphyxiation. Pipelines shall be provided with a water-sealed trap and vent, or similar device, if there is a potential, based on design configuration, for gases to enter buildings or other confined spaces.

Ponds and uncovered fabricated structures for liquid or slurry waste with walls less than 5 feet above ground surface shall be fenced and warning signs posted to prevent children and others from using them for other than their intended purpose.

Erosion Protection. Embankments and disturbed areas surrounding the facility shall be treated to control erosion.

Liners. Liners shall meet or exceed the criteria in Conservation Practice Standard 521, Pond Sealing or Lining.

ADDITIONAL CRITERIA FOR WASTE STORAGE PONDS

Soil and foundation. The pond shall be located in soils with an acceptable permeability that meets all applicable regulation, or the pond shall be lined. Information and guidance on controlling seepage from waste impoundments can be found in the Agricultural Waste Management Field Handbook (AWMFH), Appendix 10D.

The pond shall have a bottom elevation that is a minimum of 2 feet above the seasonal high water table unless features of special design are incorporated that address buoyant forces, pond seepage rate and non-encroachment of the water table by contaminants. The water table may be lowered by use of perimeter drains, if feasible, to meet this requirement.

National Engineering Manual, Part 531, Geology, specifies geologic investigation requirements and soil transportation regulations.

Maximum Operating Level. The maximum operating level for waste storage ponds shall be the pond level that provides for the required volume less the volume contribution of precipitation and runoff from the 25-year, 24-hour storm event plus the volume allowance for residual solids after liquids have been removed. A permanent marker or recorder shall be installed at this maximum operating level to indicate when drawdown should begin. The marker or recorder shall be referenced and explained in the O&M plan.

Outlet. No outlet shall automatically release storage from the required design volume. Manually operated outlets shall be of permanent type designed to resist corrosion and plugging.

Embankments. The minimum elevation of the top of the settled embankment shall be 2 feet above the waste storage pond's required volume. This height shall be increased by the amount needed to ensure that the top elevation will be maintained after settlement. This increase shall be not less than 5 percent.

The minimum top widths are shown in **Table 1**. The combined side slopes of the settled embankment shall not be less than 5 horizontal to 1 vertical (5H:1V), and neither slope shall be steeper than 2H:1V unless provisions are made to provide stability. The inside slope of all waste storage ponds shall not be steeper than 3H:1V.

Table 1
Minimum Top Widths

Total Embankment Height – Feet	Top Width Feet
15 or less	8
15-20	10

Excavations. Unless supported by a soil investigation, excavated side slopes shall be no steeper than 2H:1V.

ADDITIONAL CRITERIA FOR FABRICATED STRUCTURES

Foundation. The foundations of fabricated waste storage structures shall be proportioned to safely support all superimposed loads without excessive movement or settlement.

Where a non-uniform foundation cannot be avoided or applied loads may create highly variable foundation loads, settlement should be calculated from site-specific soil test data. Index tests of site soil may allow correlation with similar soils for which test data is available. If no test data is available, presumptive bearing strength values for assessing actual bearing pressures may be obtained from **Table 2** or another nationally recognized building code. In using presumptive bearing values, adequate detailing and articulation shall be provided to avoid distressing movements in the structure.

Table 2
Presumptive Bearing Stress Values[1]

Foundation Description	Allowable Stress
Crystalline Bedrock	12,000 psf
Sedimentary Rock	6,000 psf
Sandy Gravel or Gravel	5,000 psf
Sand, Silty Sand, Clayey Sand, Silty Gravel, Clayey Gravel	3,000 psf
Clay, Sandy Clay, Silty Clay, Clayey Silt	2,000 psf

[1] Basic Building Code, 12th Edition, 1993, Building Officials and Code Administrators, Inc. (BOCA)

Foundations consisting of bedrock with joints, fractures, or solution channels shall be treated or a separation distance provided consisting of a minimum of 1 foot of impermeable soil between the floor slab and the bedrock or an alternative that will achieve equal protection.

Liquid Tightness. Applications such as tanks, that require liquid tightness shall be designed and constructed in accordance with standard engineering and industry practice appropriate for the construction materials used to achieve this objective.

Structural Loadings. Waste storage structures shall be designed to withstand all anticipated loads including internal and external loads, hydrostatic uplift pressure, concentrated surface and impact loads, water pressure due to seasonal high water table, and frost or ice pressure and load combinations in compliance with this standard and applicable local building codes.

The lateral earth pressures should be calculated from soil strength values determined from the results of appropriate soil tests. Lateral earth pressures can be calculated using the procedures in TR-74. If soil strength tests are not available, the presumptive lateral earth pressure values indicated in **Table 3** shall be used.

Lateral earth pressures based upon equivalent fluid assumptions shall be assigned according to the following conditions:

- **Rigid frame or restrained wall.** Use the values shown in **Table 3** under the column "Frame tanks," which gives pressures comparable to the at-rest condition.
- **Flexible or yielding wall.** Use the values shown in **Table 3** under the column "Free-standing walls," which gives pressures comparable to the active condition. Walls in this category are designed on the basis of gravity for stability or are designed as a cantilever having a base wall thickness to height of backfill ratio not more than 0.085.

Internal lateral pressure used for design shall be 65 lb/ft^2 where the stored waste is not protected from precipitation. A value of 60 lb/ft^2 may be used where the stored waste is protected from precipitation and will not become saturated. Lesser values may be used if supported by measurement of actual pressures of the waste to be stored. If heavy equipment will be operated near the wall, an additional two feet of soil surcharge shall be considered in the wall analysis.

Tank covers shall be designed to withstand both dead and live loads. The live load values for covers contained in ASAE EP378.3, Floor and Suspended Loads on Agricultural Structures Due to Use, and in ASAE EP393.2, Manure Storages, shall be the minimum used. The actual axle load for tank wagons having more than a 2,000 gallon capacity shall be used.

If the facility is to have a roof, snow and wind loads shall be as specified in ASAE EP288.5, Agricultural Building Snow and Wind Loads. If the facility is to serve as part of a foundation or support for a building, the total load shall be considered in the structural design.

Structural Design. The structural design shall consider all items that will influence the performance of the structure, including loading assumptions, material properties and construction quality. Design assumptions and construction requirements shall be included in the design narrative.

Tanks may be designed with or without covers. Covers, beams, or braces that are integral to structural performance must be indicated on the construction drawings. The openings in covered tanks shall be designed to accommodate equipment for loading, agitating, and emptying. These openings shall be equipped with grills or secure covers for safety, and for odor and vector control.

All structures shall be underlain by free draining material or shall have a footing located below the anticipated frost depth. Fabricated structures shall be designed according to the criteria in the following references as appropriate:

- Steel: "Manual of Steel Construction", American Institute of Steel Construction.
- Timber: "National Design Specifications for Wood Construction", American Forest and Paper Association. Concrete: "Building Code Requirements for Reinforced Concrete, ACI 318", American Concrete Institute.
- Masonry: "Building Code Requirements for Masonry Structures, ACI 530", American Concrete Institute.

TABLE 3 - LATERAL EARTH PRESSURE VALUES[1]

Soil		Equivalent fluid pressure (lb/ft^2/ft of depth)			
		Above seasonal high water table[2]		Below seasonal high water table[3]	
Description[4]	Unified Classification[4]	Freestanding Walls	Frame Tanks	Freestanding Walls	Frame Tanks
Clean gravel, sand or sand-gravel mixtures (maximum 5% fines)[5]	GP, GW, SP, SW	30	50	80	90
Gravel, sand, silt and clay mixtures (less than 50% fines) Coarse sands with silt and and/or clay (less than 50% fines)	All gravel sand dual symbol classifications and GM, GC, SC, SM, SC-SM	35	60	80	100
Low-plasticity silts and clays with some sand and/or gravel (50% or more fines)	CL, ML, CL-ML	45	75	90	105
Fine sands with silt and/or clay (less than 50% fines)	SC, SM, SC-SM				
Low to medium plasticity silts and clays with little sand and/or gravel (50% or more fines)	CL, ML, CL-ML	65	85	95	110
High plasticity silts and clays (liquid limit more than 50)[6]	CH, MH	-	-	-	-

[1] For lightly-compacted soils (85% to 90% maximum standard density.) Includes compaction by use of typical farm equipment.
[2] Also below seasonal high water table if adequate drainage is provided.
[3] Includes hydrostatic pressure.
[4] All definitions and procedures in accordance with ASTM D 2488 and D 653.
[5] Generally, only washed materials are in this category
[6] Not recommended. Requires special design if used.

Slabs on Grade. Slab design shall consider the required performance and the critical applied loads along with both the subgrade material and material resistance of the concrete slab. Where applied point loads are minimal and liquid-tightness is not required, such as barnyard and feedlot slabs subject only to precipitation, and the subgrade is uniform and dense, the minimum slab thickness shall be 4 inches with a maximum joint spacing of 10 feet. Joint spacing can be increased if steel reinforcing is added based on subgrade drag theory.

For applications where liquid-tightness is required such as floor slabs of storage tanks, the minimum thickness for uniform foundations shall be 5 inches and shall contain distributed reinforcing steel. The required area of such reinforcing steel shall be based on subgrade

drag theory as discussed in industry guidelines such as such as American Concrete Institute, ACI 360, "Design of Slabs-on-Grade".

When heavy equipment loads are to be resisted and/or where a non-uniform foundation cannot be avoided, an appropriate design procedure incorporating a subgrade resistance parameter such as ACI 360 shall be used.

CONSIDERATIONS APPLICABLE TO ALL WASTE STORAGE FACILITIES

Waste storage facilities should be located as close to the source of waste and polluted runoff as practicable.

Non-polluted runoff should be excluded from the structure to the fullest extent possible except where its storage is advantageous to the operation of the agricultural waste management system.

Freeboard for waste storage tanks should be considered.

Solid/liquid separation of runoff or wastewater entering pond facilities should be considered to minimize the frequency of accumulated solids removal and to facilitate pumping and application of the stored waste.

Due consideration should be given to environmental concerns, economics, the overall waste management system plan, and safety and health factors.

CONSIDERATIONS FOR MINIMIZING THE POTENTIAL FOR AND IMPACTS OF SUDDEN BREACH OF EMBANKMENT OR ACCIDENTAL RELEASE FROM THE REQUIRED VOLUME

Features, safeguards, and/or management measures to minimize the risk of failure or accidental release, or to minimize or mitigate impact of this type of failure should be considered when any of the categories listed in **Table 4** might be significantly affected.

Table 4
Potential Impact Categories from Breach of Embankment or Accidental Release

1. Surface water bodies -- perennial streams, lakes, wetlands, and estuaries
2. Critical habitat for threatened and endangered species.
3. Riparian areas
4. Farmstead, or other areas of habitation
5. Off-farm property
6. Historical and/or archaeological sites or structures that meet the eligibility criteria for listing in the National Register of Historical Places.

The following should be considered, either singly or in combination, to minimize the potential of, or the consequences of, sudden breach of embankments when one or more of the potential impact categories listed in **Table 4** may be significantly affected:

- An auxiliary (emergency) spillway
- Additional freeboard
- Storage for wet year rather than normal year precipitation
- Reinforced embankment, such as additional top width, flattened and/or armored downstream side slopes
- Secondary containment

The following options should be considered to minimize the potential for accidental release from the required volume through gravity outlets when one or more of the potential impact categories listed in **Table 4** may be significantly affected:

- Outlet gate locks or locked gate housing
- Secondary containment
- Alarm system
- Another means of emptying the required volume

LINING REQUIREMENTS

Flexible membrane liners shall be used for all waste storage facilities installed as a pond in accordance with New Mexico Conservation Practice Standard 521A unless the owner of the waste storage pond independently obtains the services of a licensed professional engineer that will certify to the NMED that the

alternative lining or process will satisfy the requirement that there will not be a hydrologic connection to surface water.

CONSIDERATIONS FOR IMPROVING AIR QUALITY

To reduce emissions of greenhouse gases, ammonia, volatile organic compounds, and odor, other Conservation Practice Standards such as Composting Facility – 317, Waste Facility Cover – 367, Anaerobic Digester, Ambient Temperature - 365, and Anaerobic Digester, Controlled Temperature - 366, can be added to the waste management system.

Adjusting pH below 7 may reduce ammonia emissions from the waste storage facility but may increase odor when waste is surface applied (see Conservation Practice Standard 633, Waste Utilization.

In rural areas where odors are a concern, an aerobic lagoon should be considered instead of a waste storage pond. This should be especially considered where odors would affect neighboring farms having enterprises that do not cause odors and/or neighbors who earn a living off-farm. The recommended loading rate for anaerobic lagoons at sites where odors must be minimized is one-half the value given in AWMFH Figure 10-22.

For sites located near urban areas practices such as the following should be considered to reduce odor emissions:

- Covering the storage facility with a suitable cover. Some fabric and organic covers have been shown to be effective in reducing odors.
- Using naturally aerated or mechanically aerated lagoons.
- Using composting in conjunction with a solid waste system rather than a liquid or slurry system.
- Using a methane digester and capture system.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design.

The plan shall contain the operational requirements for emptying the storage facility. This shall include the requirement that waste shall be removed from storage and utilized at locations, times, rates, and volume in accordance with the overall waste management system plan.

In addition, for ponds, the plan shall include an explanation of the permanent marker or recorder installed to indicate the maximum operating level.

The plan shall include a strategy for removal and disposition of waste with the least environmental impact during the normal storage period to the extent necessary to insure the pond's safe operation. This strategy is for the removal of the contribution of unusual storm events that may cause the pond to fill to capacity prematurely with subsequent design inflow and usual precipitation prior to the end of the normal storage period.

Development of an emergency action plan should be considered for waste storage facilities where there is a potential for significant impact from breach or accidental release. The plan shall include site-specific provisions for emergency actions that will minimize these impacts.

DRAWINGS AND SPECIFICATIONS

Drawings and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

REFERENCES

ASAE, 1984. D384 – Manure Production and Characteristics. ASAE. St. Joseph, MI.

Midwest Plan Service. 1985. Livestock Waste Facilities Handbook. MWPS, Department of Agricultural and Bio-systems Engineering, Iowa State University, Ames, IA.

New Mexico Water Quality Control Commission. 1995. 20 NMAC 6.2, Ground and Surface Water Protection, Santa Fe, NM.

USDA Natural Resources Conservation Service, 1992. Agricultural Waste Management Field Handbook. USDA-NRCS. Washington, DC.

National Engineering Manual, Part 531, Geology,